BEST MANAGEMENT PRACTICES

Controlling Soil Erosion on the Farm

A practical guide to help Ontario farmers solve soil erosion problems

Canada

Ontario

OFA Ontario Federation of Agriculture

Soil erosion remains a key challenge for Ontario agriculture. It reduces cropland productivity and can contribute to the pollution of adjacent watercourses, wetlands and lakes.

Cropland erosion can be controlled.

This booklet is intended to:

- help you identify soil erosion problems on your farm, and
- provide an overview of erosion control solutions.

Sources of more information and assistance are provided in the back pages.

What is a Best Management Practice or "BMP"?

- a proven, practical and affordable approach to conserving soil, water and other natural resources in rural areas

What is the BMP Series?

- innovative, award-winning books presenting many options that can be tailored to meet your particular environmental concern and circumstances
- current BMP titles are:

A Phosphorus Primer
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Managing Crop Nutrients
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Nutrient Management Planning
No-Till: Making It Work
Pesticide Storage, Handling and Application
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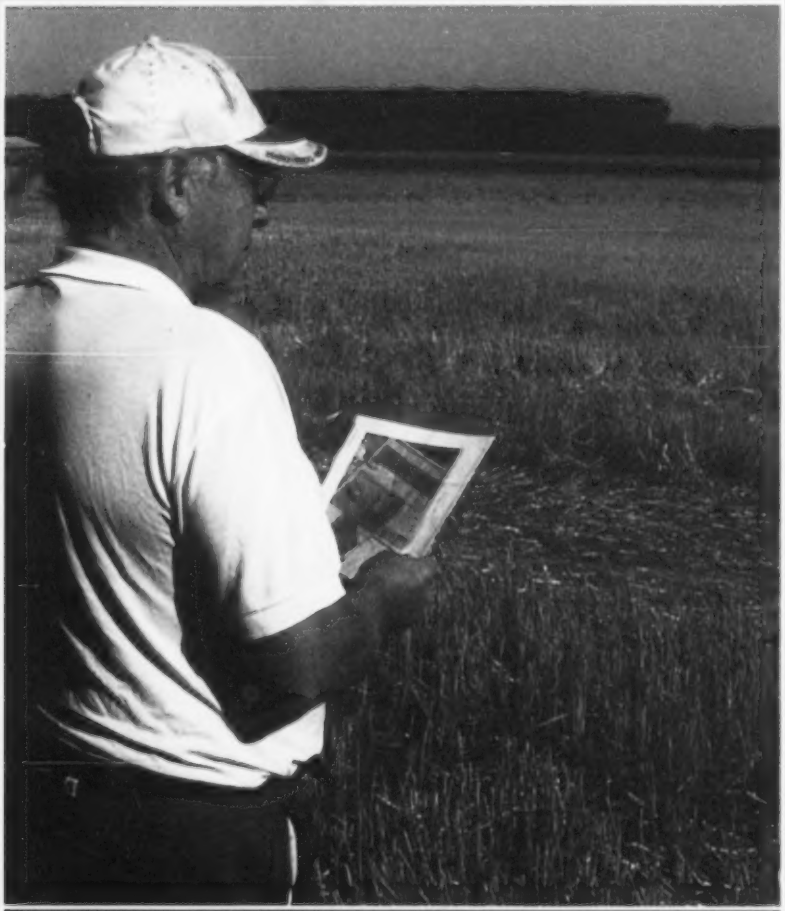
Streamside Grazing
Water Management
Water Wells
Woodlot Management



"We only have about six inches of topsoil, and I would like to leave it for the next generation."

Dan Veldman, Oxford County

For information on how to obtain your free copies of BMP books, please see page 36.

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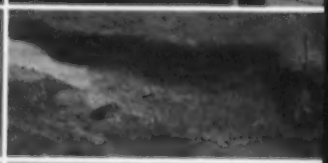

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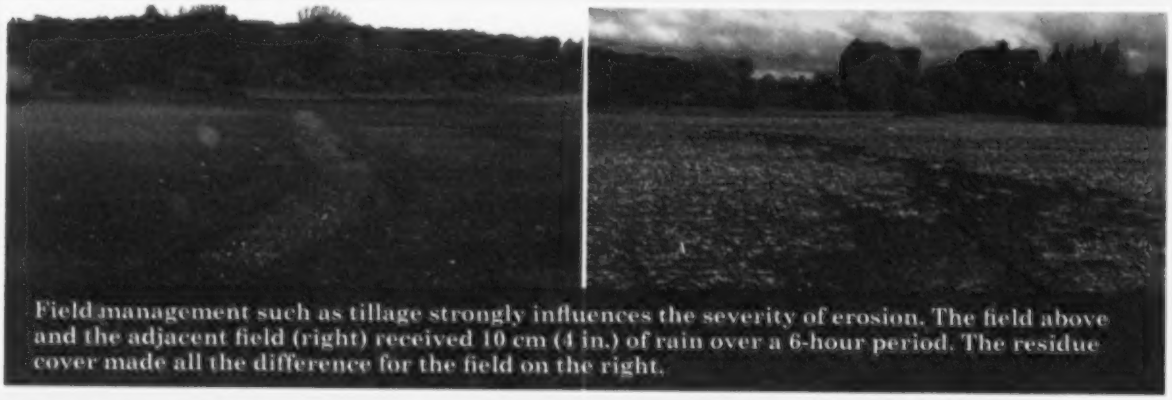
The Foundation of Erosion Control

The measures you choose to control soil erosion will depend on many factors – including the type and scope of the problem on your farm, and your cropping and management systems.

Other factors to consider:

- effects on your operation over the short and long term
- costs and maintenance requirements
- overall effectiveness of the preferred solution
- off-farm impact, e.g. road and ditch maintenance, impact on neighbours.

The solution may be simple and not that costly, especially when you compare it to the true cost of farming around or with the problem.



Field management such as tillage strongly influences the severity of erosion. The field above and the adjacent field (right) received 10 cm (4 in.) of rain over a 6-hour period. The residue cover made all the difference for the field on the right.

Erosion – whether it is wind, water or tillage – is a natural process with two distinct actions: soil detachment and movement. All erosion control methods are based on preventing detachment or reducing the carrying power of wind, water or tillage.

Managing water movement across a field is an important first step. Many erosion control structures take water underground or protect the soil surface from concentrated water flows.

Effective surface drainage systems such as drop inlets and other structures reduce overland flow of water, in turn reducing soil detachment and movement.

Keep a protective cover on your fields throughout as much of the year as possible. Diverse crop rotations and the use of cover crops out of season can serve to cover and protect the soil surface. Always look at your tillage system first: you can spend money on structures and other techniques, but they may not be effective without conservation tillage/cropping practices and crop rotations in place.

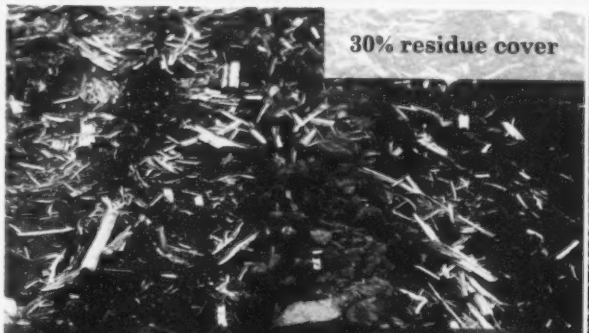
In soil conservation, a systems approach is encouraged to prevent, reduce and control erosion. Soil management BMPs improve soil quality and resilience to erosion and other forms of degradation. Conservation cropping and tillage BMPs keep soil covered. Surface drainage and erosion control structures manage the movement of water on cropland – reducing erosion and runoff.

A Note on Watersheds In this booklet, a watershed refers to an area of cropland where all surface water and groundwater flow to the same point. BMPs for runoff and erosion control are selected and designed based on watershed characteristics – including size, slope grade, slope length, cover and soil type.

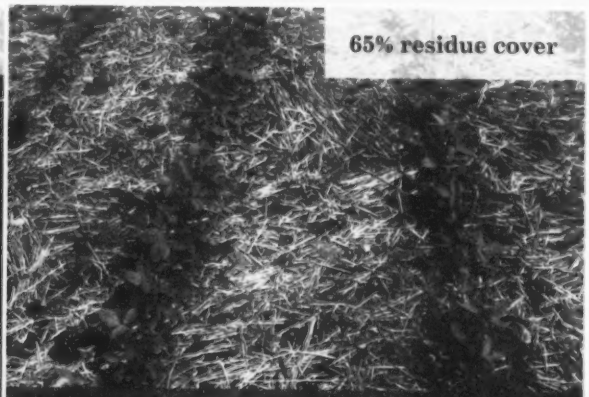
The Foundation of Erosion Control

BMPs for soil, cropping and tillage

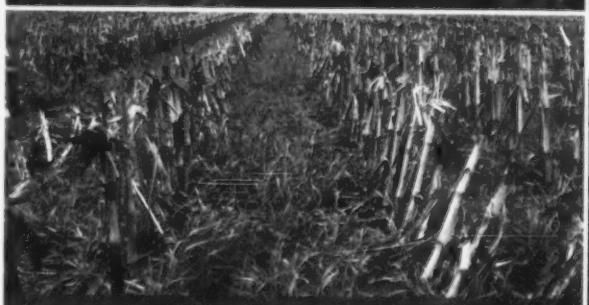
Conservation cropping and tillage options are the foundation of all erosion control.
A healthy soil is resistant to soil erosion. Conservation tillage, good crop rotation, cover crops, and organic matter additions are sound strategies for building soil health.



An effective conservation tillage program leaves 30–70% of the soil surface covered with residue after planting throughout the rotation cycle.

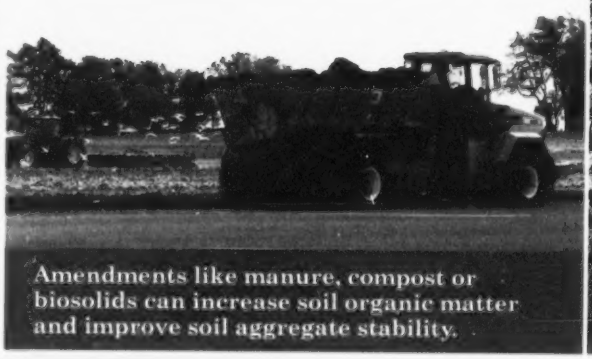


Crop residue protects soil particles from erosion and adds organic matter to the soil.

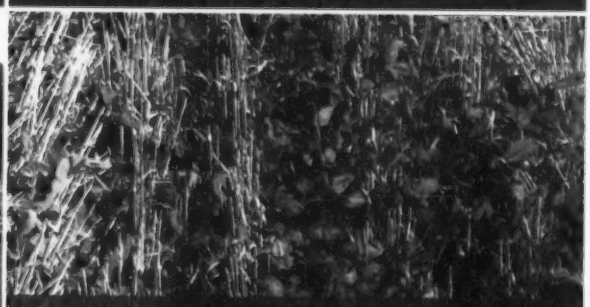


Seeding cover crops after early harvested field and vegetable crops keeps the soil covered and helps to anchor residue.

Crop rotations involving forage crops will reduce soil erosion by up to 40%.



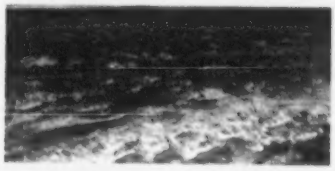
Amendments like manure, compost or biosolids can increase soil organic matter and improve soil aggregate stability.



Red clover underseeded in wheat gives almost continuous cover and a nitrogen credit while improving soil.

From Problem to Solution

WHAT ARE YOU SEEING?	TYPE OF EROSION	SUGGESTED SOLUTIONS
symptoms/observations	**conditions where applicable**	**best management practices**
Erosion is evident on shoulder slopes of hills (i.e. white caps) More erosion is evident than expected based on soil types and slope Crops become stressed more quickly under adverse conditions in the shoulder slope area There is an accumulation of soil or layers of soil in lower-slope positions Yields are low on shoulder slopes and knolls	**Tillage Erosion** see page 6 *Most commonly seen on:* • rolling or gently sloping fields • fields that have been in conventional tillage for many years Note: effects may be seen many years after tillage is reduced 	Adopt mulch tillage or no-till Work across slope or with the contour Change tillage direction to move soil up slope Reduce speed/intensity of tillage *More severe cases:* • remediate (rebuild) by returning displaced soils to upper-slope positions
There is a buildup of soil at the bottom of the slope with no apparent rills or gullies Knolls are light-coloured Yields are low on shoulder slopes and knolls	**Sheet Erosion** see page 6 *Most commonly seen on:* • loams and clay loam soils with reduced water infiltration • fields with long shallow slopes or short steep slopes *To assist in designing a solution, consider the length of field and slope:* • up to 152 m (500 ft) and up to 2% slope • longer than 152 m (500 ft) and greater than 2% slope	*Start by:* • increasing crop residue cover with mulch tillage or no-till • improving crop rotation (more cover) • adding organic amendments (e.g. manure) • changing cropping and tillage direction (cross-slope or cross-slope on contour) *More severe cases:* • establish strip cropping • construct field and diversion terraces
You see finger-like flow channel patterns on slope There is a clear path where water has been flowing You need to slow down when crossing an infield draw (natural drainageway) due to soil erosion	**Rill Erosion** see page 9 *Most commonly seen on:* • fields where water flow starts to concentrate • sloping fields • fields tilled or planted up and down slope *When designing a solution, consider the size of the watershed delivering stormwater to the rill area:* • up to 2 ha (5 ac) • from 2 ha up to 10 ha (5–25 ac) • from 10 ha up to 14 ha (25–35 ac) • greater than 14 ha (35 ac)	<u>Small rill</u> Increase crop residue cover with mulch tillage or no-till Improve crop rotation Apply organic amendments Change cropping and tillage direction Install vegetated filter strip (preferably on contour) <u>Large rill</u> Construct a diversion terrace or water and sediment control basin (WASCoB), incorporating earthen berms or grassed waterways depending on site characteristics

WHAT ARE YOU SEEING?	TYPE OF EROSION	SUGGESTED SOLUTIONS
symptoms/observations	**conditions where applicable**	**best management practices**
Finger-like pattern of small channels in soil has grown to be large and deep e.g. 30–60 cm (1–2 ft) rills Size/depth of water flow-path does not allow vehicles to cross	**Gully Erosion** see page 9 *Most commonly seen on:* • areas of field with concentrated water flow • steeply sloping fields • soils with a high sand/silt content 	*Follow this 2-step strategy:* 1. Reduce the amount of water flowing through the area by using water and sediment control basins (WASCoBs)/diversion terracing 2. Stabilize the gully area by establishing permanent vegetative cover and grassed waterways/grade control structures
Concentrated runoff is flowing over the bank and into the watercourse Drainpipe outlets are unstable and soil has washed out from around them The banks of the stream or drainage channel are being undercut and scoured Livestock with uncontrolled access are causing damage to the banks	**Bank Erosion** see page 21 	Fence livestock from watercourse Vegetate banks and establish buffer strips along bank edge Protect subsurface drainage outlets with rock riprap Construct rock chute spillways or drop-pipe inlets at critical points where concentrated flows enter the drainage channel
Airborne soil is regularly seen under windy conditions During winter, the snow cover has a brown colour Soil has accumulated on the leeward side of any type of barrier such as fence rows, buildings, trees, ditches or streams The soil surface appears smooth or rippled, like beach sand Crops have been exposed, sandblasted or buried by soil	**Wind Erosion** see page 25 *Most commonly seen on:* • large fields with little protection to reduce the wind speed • finely worked seedbeds • soils with a high sand content *Consider the size of the problem:* • is it isolated areas within a field? • is it large areas of the field or whole fields? 	*Start by:* • increasing crop residue cover with mulch tillage or no-till • diversifying crop rotation to increase residues and provide soil cover Roughen soil surface (contingency measure) Plant cover crops, windbreaks Improved soil moisture management (e.g. irrigation timing) may also be required
Evidence of severe erosion in the past Slopes are very steep There is complex topography or irregular-shaped portion of field Poor yields or inconsistent production most years Response to crop inputs is poor	**Highly Erodible Land** see page 30 *All types of erosion:* • tillage, water, wind 	Convert to permanent pasture or hay Convert to trees for timber production Retire to shrubs, grasses and trees for wildlife habitat and recreational use

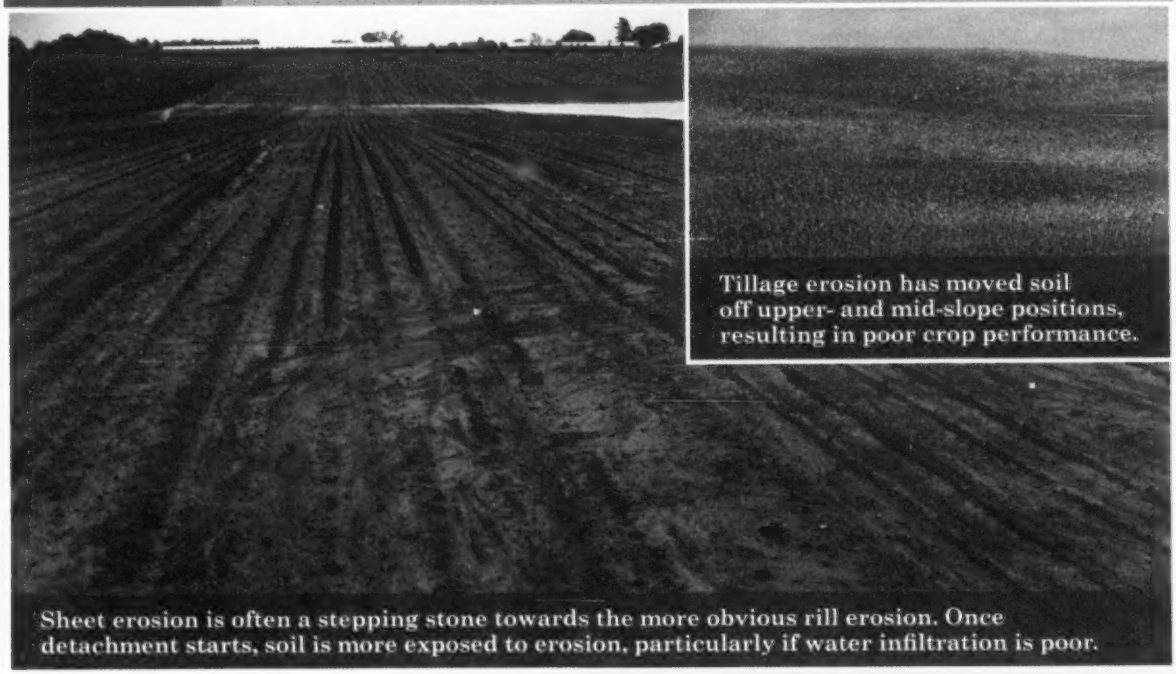
Tillage and Sheet Erosion

BMPs for tillage erosion

Tillage erosion is the redistribution of soil through the action of tillage and gravity. Typically, tillage results in the progressive downslope movement of soil, causing severe soil loss on upper-slope positions and accumulation in lower-slope positions.

Tillage implements like a plow or disc throw soil either up or down slope, depending on the direction of tillage. Combine this with gravity and you get soil movement on slopes that is often greater than that from water erosion. Tillage-eroded fields can experience soil losses of 20–100 T/ha/yr (9–45 t/ac/yr). Research has shown yield declines of up to 40% in corn in these conditions.

SOLUTION Use **mulch tillage** or **no-till** to reduce tillage erosion. If you must till, select the tillage implement with care, reduce speed and depth, and work across the slope.



Tillage erosion has moved soil off upper- and mid-slope positions, resulting in poor crop performance.

Sheet erosion is often a stepping stone towards the more obvious rill erosion. Once detachment starts, soil is more exposed to erosion, particularly if water infiltration is poor.

Sheet Erosion

Sheet erosion occurs where water begins to flow off the land. Sheet erosion is difficult to see because the soil is lost in a way similar to a few sheets of paper being peeled from a pad. Over time, the soil loss affects crop growth.

You have excessive sheet erosion if you see:

- soil deposited at the bottom of the slope with no apparent rills or gullies
- light-coloured knolls
- low yields on shoulder slopes and knolls.

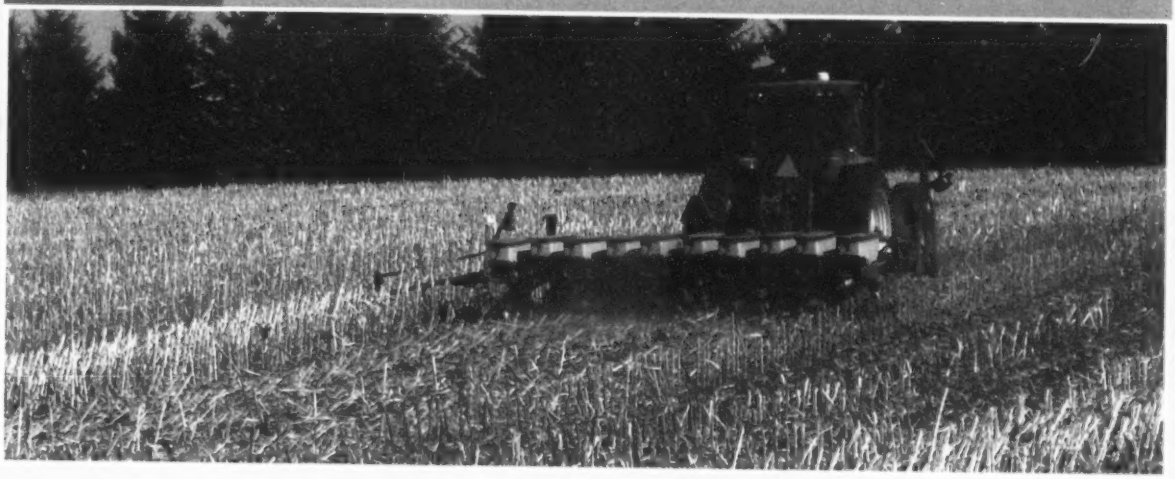
Loamy soil types are the most vulnerable to sheet erosion, but any soil with poor water infiltration will also be vulnerable. Long gradual slopes and short steep slopes are prone to sheet erosion.

BMPs for Sheet Erosion

On gently sloping fields – slopes up to 2% and up to 152 m (500 ft) long

SOLUTION

Keeping the soil covered with conservation cropping and tillage BMPs will solve most if not all sheet erosion problems on your farm.

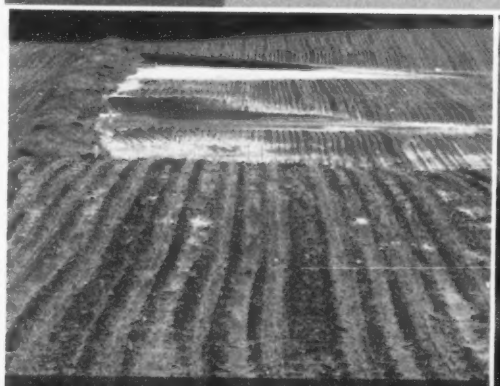


BMPs for Sheet Erosion

On steeper fields – slopes steeper than 2% and longer than 152 m (500 ft)

SOLUTION

Where slopes are longer than 152 m (500 ft) and steeper than 2% (e.g. 2 ft of rise in 100 ft length), additional BMPs may be needed. **Strip cropping** with row crops and forages or narrow-row grain may help. **Field and diversion terraces** can help with more severe landscapes. Both achieve the same goal of breaking up the slope so that cropping and tillage solutions are more effective.

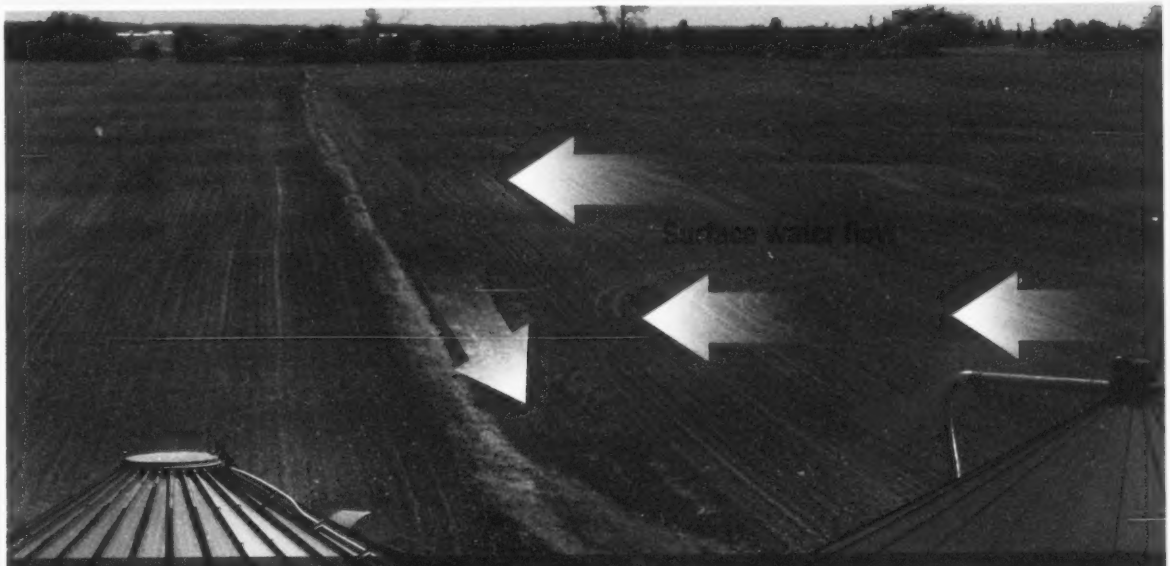


A field terrace intercepts runoff and directs it into a subsurface drainage system.

Strip cropping breaks up the slope length of a field, reducing the erosive action of water.

BMPs for Sheet Erosion

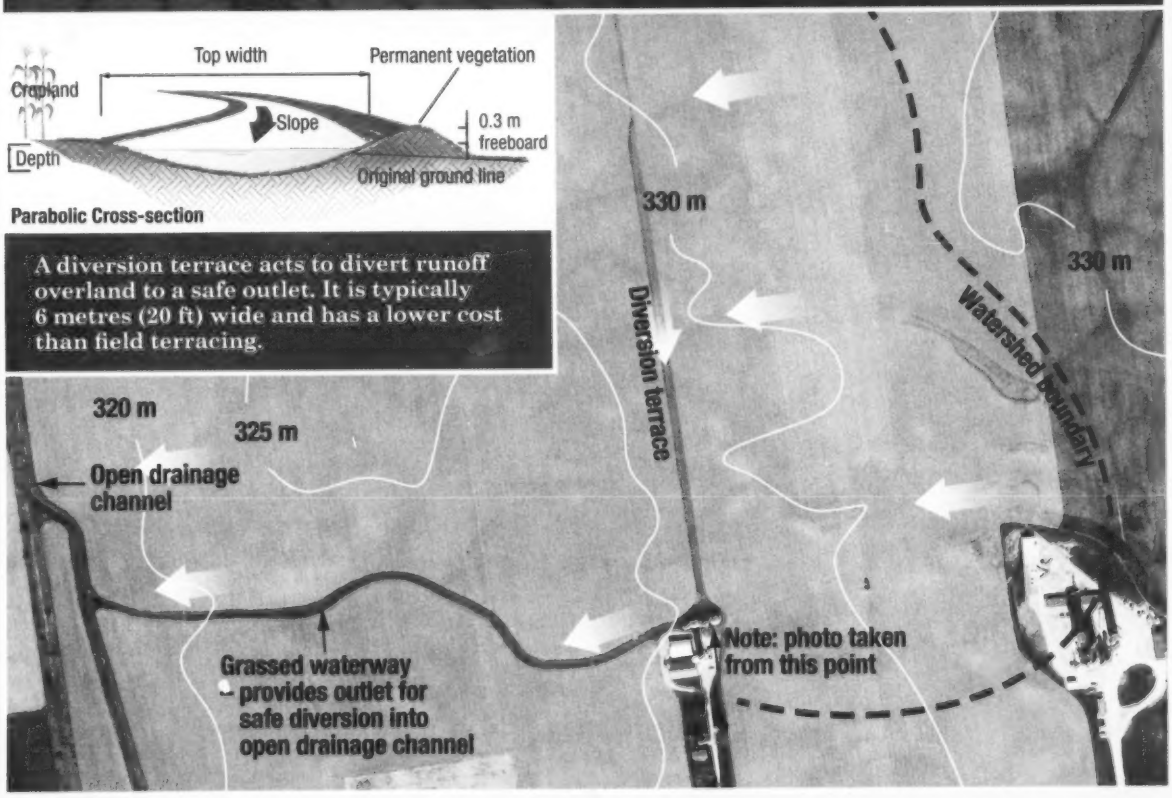
Diversion terraces



This diversion terrace was constructed in 1984, and still functions as designed. About 24 hectares (60 ac) of farmland drain into the diversion. A grassed waterway carries the flow safely into an open drainage channel. Slopes were 305 metres (1,000 ft) long and averaged 2% before the erosion plan was adopted.

Parabolic Cross-section

A diversion terrace acts to divert runoff overland to a safe outlet. It is typically 6 metres (20 ft) wide and has a lower cost than field terracing.



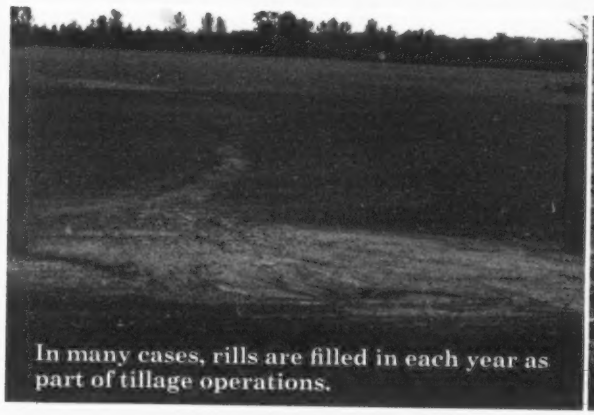
Rill Erosion

Rill erosion leaves distinct paths where the soil has been washed away, as water concentrates in draws (areas of concentrated flow) and flows down the slope.

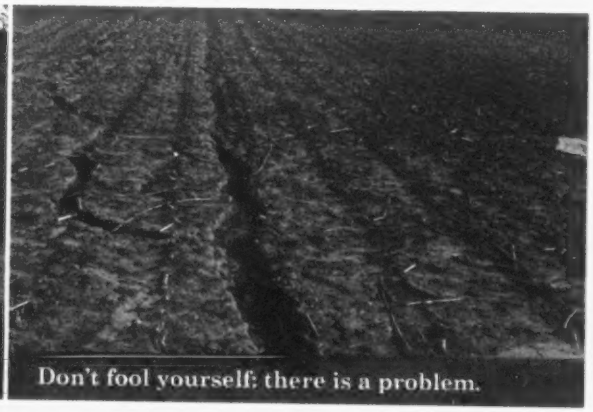
The larger the contributing watershed, the greater the slope and more confined the drainageway, then the greater the potential for rill erosion.

You are experiencing rill erosion if:

- you see finger-like patterns on sloping fields after runoff events
- there is an obvious path where water has been flowing
- you need to slow down when crossing a draw due to erosion and runoff.



In many cases, rills are filled in each year as part of tillage operations.



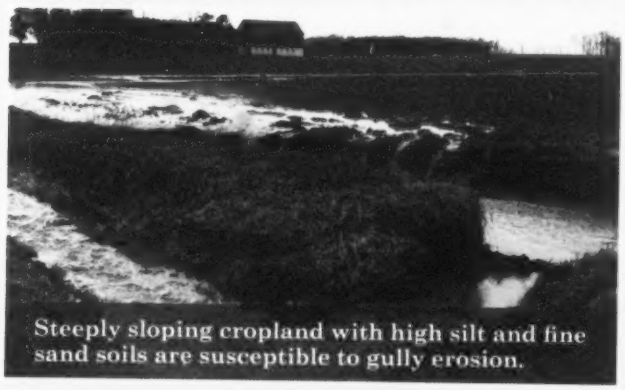
Don't fool yourself: there is a problem.

Gully Erosion

Gully erosion may develop where rill erosion has not been managed.

You have gully erosion when:

- rills (eroded channels in field) are so large that you cannot cross them with your tractor and most implements
- eroded channels have to be filled in with your tractor (and bucket or blade) or heavy equipment.



Steeply sloping cropland with high silt and fine sand soils are susceptible to gully erosion.

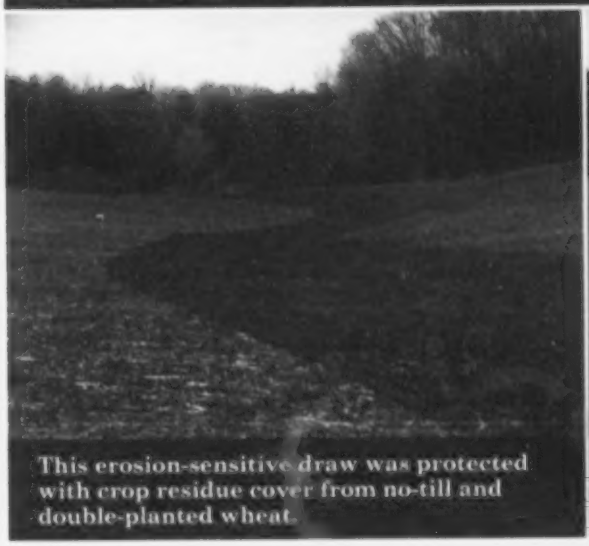
BMPs for Rill Erosion

On very small watersheds of up to 2 ha (5 ac) and/or broad drainageways

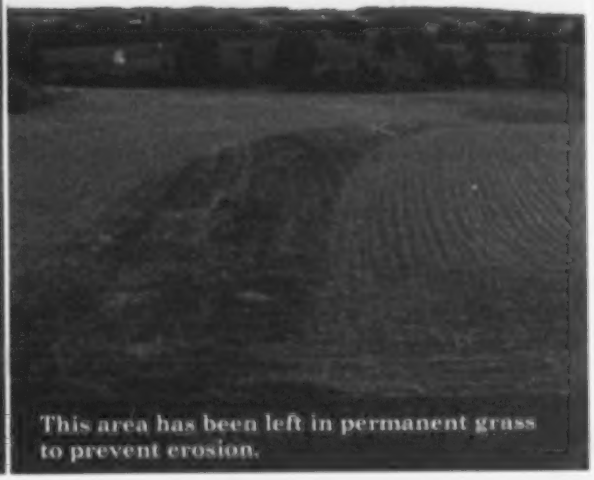
SOLUTION

In small watersheds, BMPs for cropping and tillage – including **crop rotations, along with some simple supporting practices in runoff-prone areas** – may help to control erosion.

This wide, natural draw path has been left untilled to protect the soil from erosion. The next crop will be planted directly into it.



This erosion-sensitive draw was protected with crop residue cover from no-till and double-planted wheat.



This area has been left in permanent grass to prevent erosion.

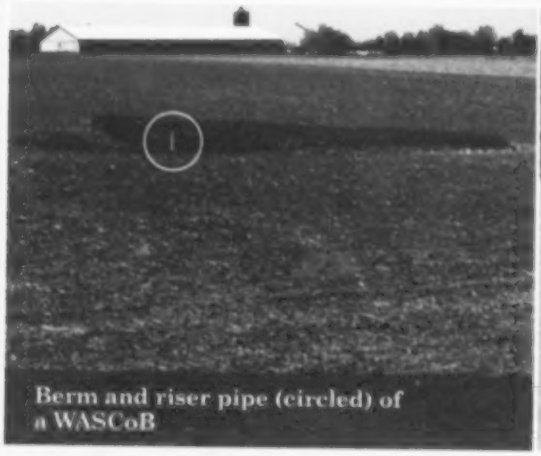
BMPs for Rill Erosion

On small, gently sloping watersheds of up to 2% slope and up to 10 ha (25 ac)

SOLUTION

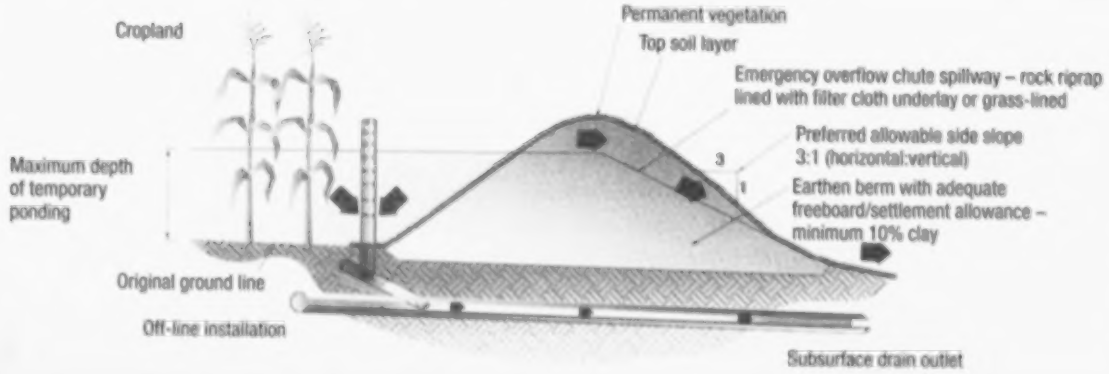
For watersheds of up to 10 hectares (25 ac), a relatively simple way to control rill erosion is the **construction of an earthen berm across the erosion-sensitive draw.** A water and sediment control basin (WASCoB) is a berm that intercepts and ponds runoff, then releases it slowly to a subsurface drainpipe in less than 24 hours. Construction and maintenance tips for an earthen berm and riser inlet can be found on pages 15 and 16.

A WASCoB system consists of an earthen dam or berm spanning a natural drainageway. It intercepts and temporarily ponds concentrated runoff. The standpipe and plastic pipe are sized to drain the ponded area within a 24-hour period. Generally this system will fit irregular landscapes. In some cases it may be preferred over a grassed waterway.



Berm and riser pipe (circled) of a WASCoB

Rills near field edges can move soil into waterways unless managed through measures such as WASCoBs.


Cropland
Permanent vegetation
Top soil layer
Emergency overflow chute spillway – rock riprap lined with filter cloth underlay or grass-lined
Preferred allowable side slope 3:1 (horizontal:vertical)
3
1
Earthen berm with adequate freeboard/settlement allowance – minimum 10% clay
Maximum depth of temporary ponding
Original ground line
Off-line installation
Subsurface drain outlet

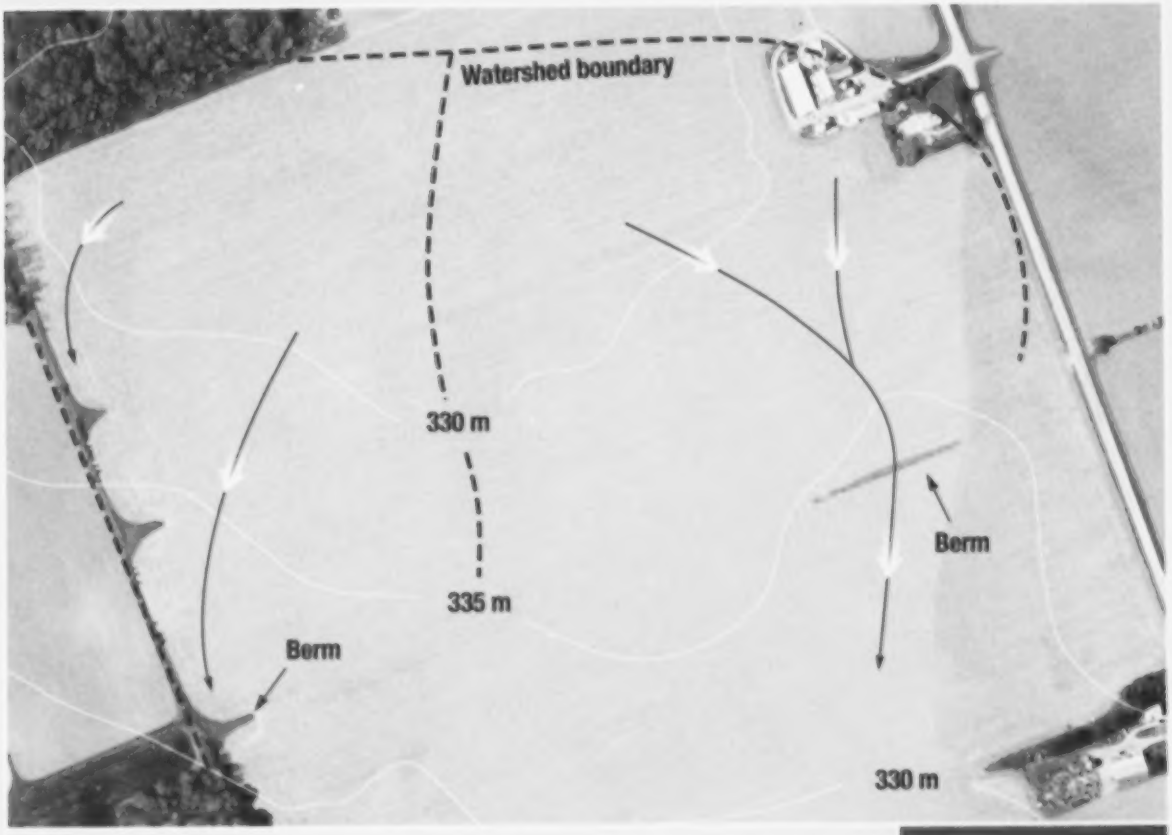
The berm cross-section may be either a broad-based or narrow-based design. The broad-based design with a 10:1 side slope enables the berm to be entirely cropped, and no land is taken out of production. The narrow-based design has 3:1 side slopes and will be permanently vegetated. The narrow-based system has a lower cost as less soil is used in the construction. Include an emergency overflow spillway for all berm systems.

BMPs for Rill Erosion

On gently sloping watersheds of 10–20 ha (25–50 ac)

This 20-hectare (50-ac) field slopes to the south. Its slope is 396 metres (1,300 ft) in length. No-till farming across the slope and a series of berms reduce soil erosion to an acceptable level.

Three L-shaped berms were built just inside the fenceline to control rill erosion along the field headlands. They are grassed over, but constructed with 8:1 slopes to allow for machinery crossing and minimize impacts on field operations. Another berm is constructed in line with the lowest L berm to protect another drainageway.



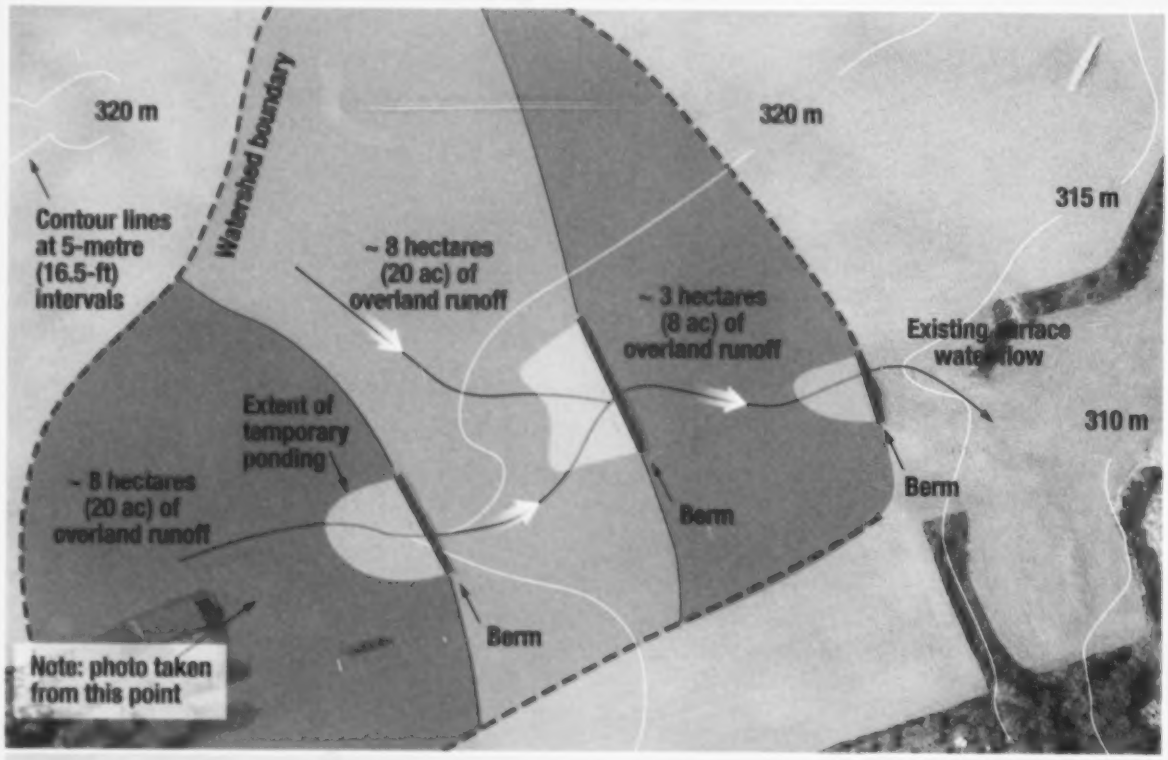
Ground view of WASCoB's riser pipe (circled)

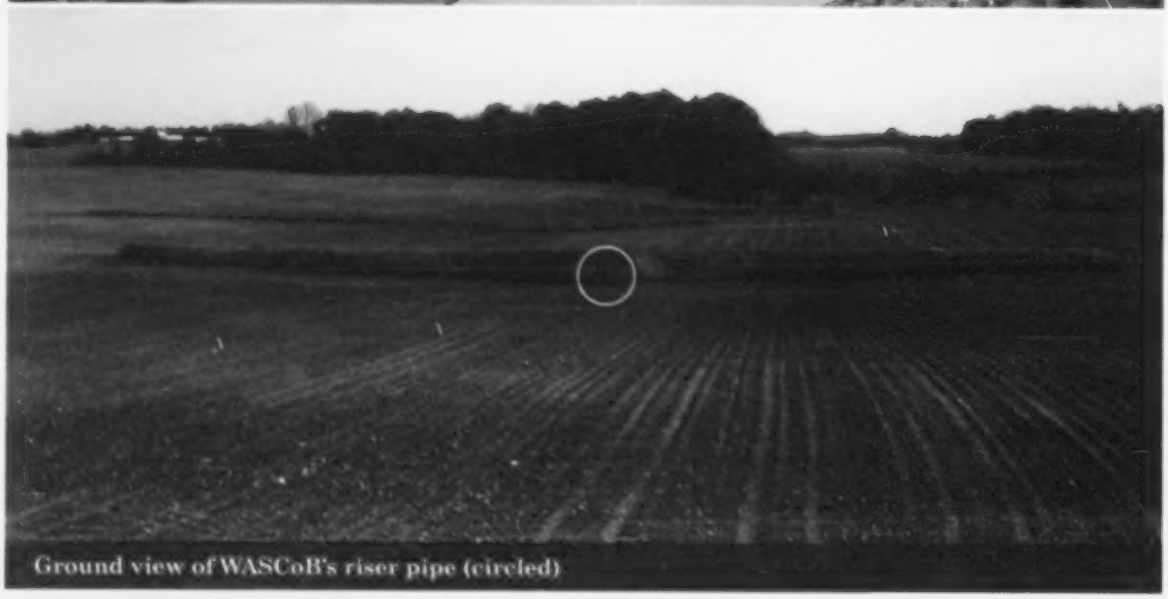
Rills along fence-line prior to berm construction

BMPs for Rill and Gully Erosion

On steeply sloping watersheds of 10–14 ha (25–35 ac)

This fairly steep 20-hectare (50-ac) watershed required three narrow-based berms (WASCoBs) to protect the drainageway from rill erosion. The berms are parallel to each other and spaced at 91 metres (300 ft). The drainageway extends over 700 metres (2,300 ft) with a slope that exceeds 5%.





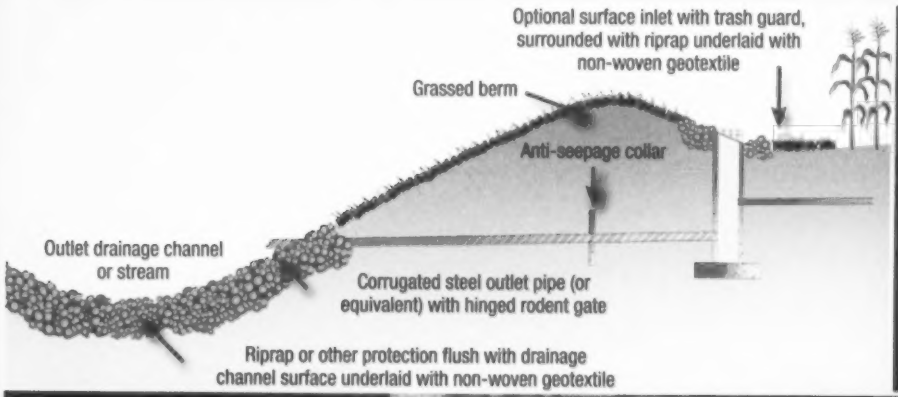
Ground view of WASCoB's riser pipe (circled)

BMPs for Gully Erosion

For concentrated flow on steep slopes or high drops

Most large rills and gulleys that develop in cropland areas can be controlled with the range of erosion control structures and conservation practices described on previous pages.

There are certain areas – such as very steep slopes in fields or concentrated flows near watercourses – that require structures like the ones listed below.


Optional surface inlet with trash guard, surrounded with riprap underlaid with non-woven geotextile
Grassed berm
Anti-seepage collar
Outlet drainage channel or stream
Corrugated steel outlet pipe (or equivalent) with hinged rodent gate
Riprap or other protection flush with drainage channel surface underlaid with non-woven geotextile

A large-diameter pipe (drop pipe) is installed to convey water down steep slopes or high drops to prevent ponded water or concentrated flow from forming large rills or gullies.

Grade control structures are often used to control or prevent gully erosion. They are a type of drop structure that reduces waterway grade by providing vertical drops up to 1 metre (3 ft) at selected locations along the channel. In most cases, gabion baskets and angular rock materials are used. These structures should always be backed with a filter cloth material to prevent soil from washing through and causing failure.

A rock chute spillway is a constructed chute using angular stone (riprap) and underlaid with filter cloth. Rock chutes are often placed in riparian areas to convey concentrated surface flows (i.e. large rills or gullies) safely to watercourses. As with all erosion control structures, rock chute spillways are most effective when managed as part of a soil conservation system.

BMPs for Construction

Earthen berms and riser inlets

Construction

- Work with a qualified professional to ensure proper design.
- Ensure that the proposed berm height is achieved and allows for freeboard and settling – freeboard is an allowance of a further 15 cm (6 in.) of berm height to provide emergency protection.
- Dress the structure with topsoil to promote vegetative growth.
- Whenever possible, construct earthen berms and terraces in the same direction as crop rows to minimize inconvenience during field operations.
- Install all subsurface drainpipe prior to berm construction to avoid differential settling. Drainpipe sizes can be reduced since runoff is stored and outletted within a 24-hour period.

"Proper design is a big part of the project. If it's not done right, it's not going to work – worse, it will give these projects a bad reputation."

Peter Dimmers, Oxford County

Topsoil must be scraped away and stockpiled for later replacement following construction.

Use subsoils that are free of stones and debris and have a minimum clay content of 10%. Build in 15-centimetre (6-in.) layers, compacting progressively.

BMPs for Maintenance

Earthen berms and riser inlets

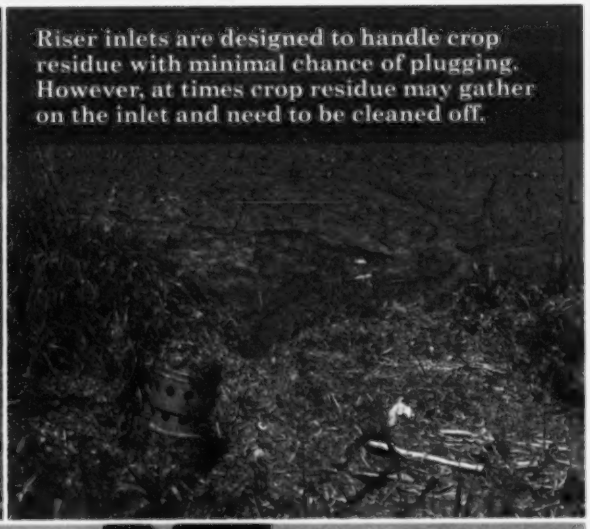
Maintenance

Maintenance is essential to ensure the long-term integrity of the structural erosion control system.

- Inspect the berm, inlet and subsurface drainage system regularly for burrowing animals, cracking, settling and other concerns.
- Consider mowing at least twice a year to control woody vegetative growth.

Protect the ponding area from excessive sedimentation by using crop rotations and conservation tillage. If there is excess sediment buildup within the ponding area, have it removed to keep the system working optimally.

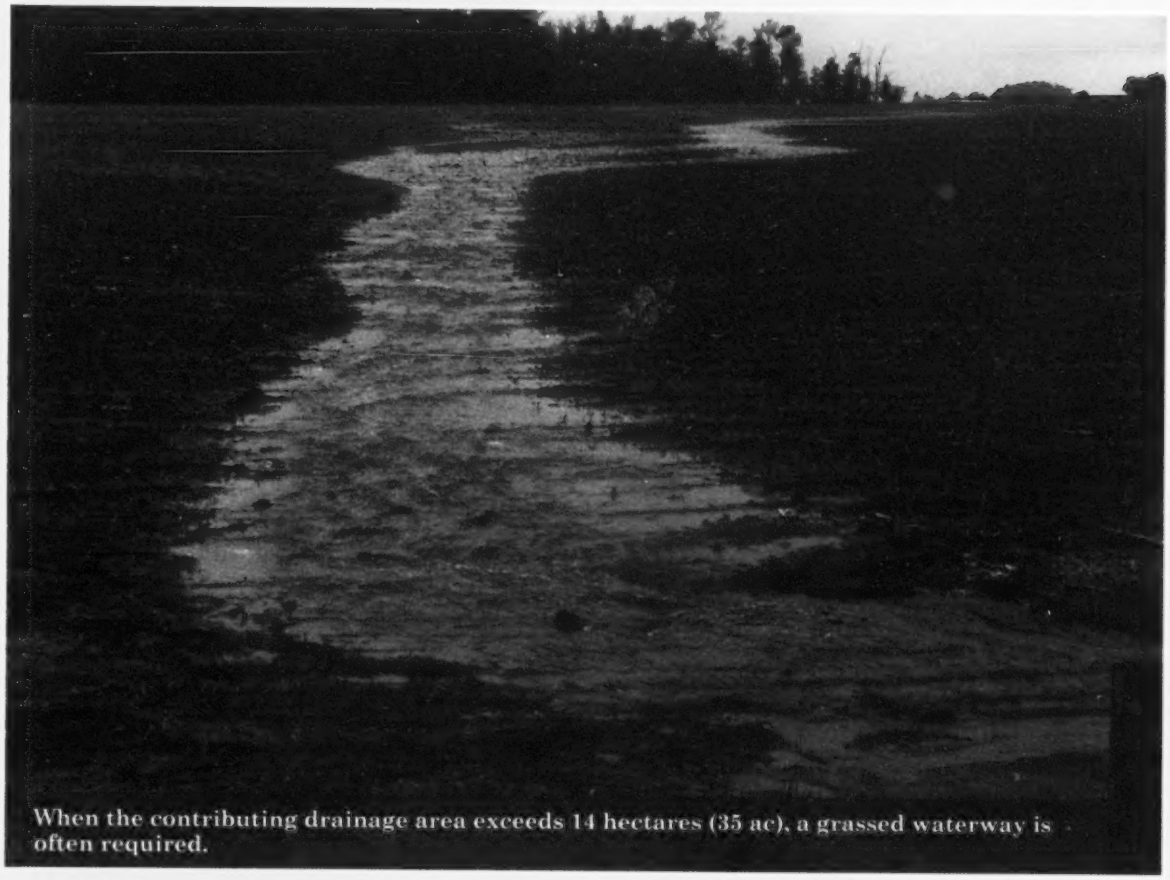
Riser inlets are designed to handle crop residue with minimal chance of plugging. However, at times crop residue may gather on the inlet and need to be cleaned off.



Check the emergency spillway, especially after extreme runoff events. Carry out necessary repairs immediately.

BMPs for Rill Erosion

On gently sloping, large watersheds of more than 14 ha (35 ac)



When the contributing drainage area exceeds 14 hectares (35 ac), a grassed waterway is often required.

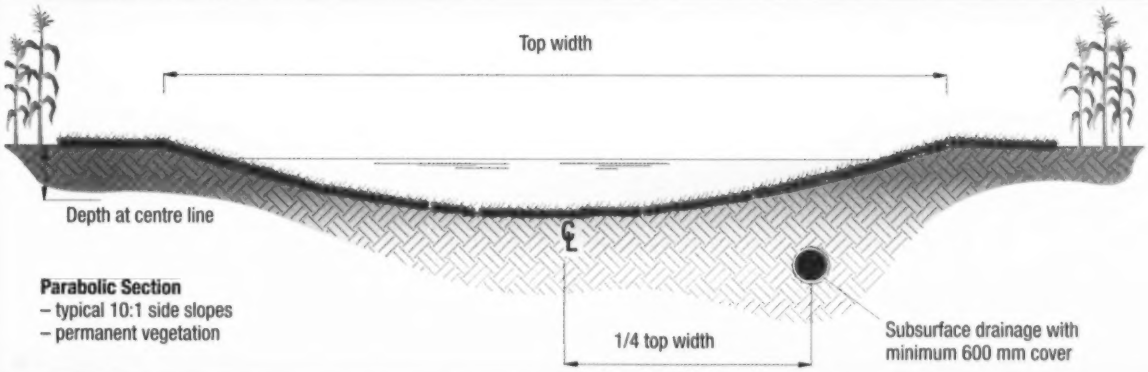
BMPs for Rill Erosion

On large watersheds of more than 14 ha (35 ac)

SOLUTION

A **grassed waterway** is a broad, shallow, permanently vegetated channel, designed to safely convey concentrated runoff from farm fields to a stable outlet. The waterway will follow the natural drainageway to protect against rill and gully erosion.

Enlist the help of professionals such as erosion control contractors to properly design grassed waterways.



Design details: permanent vegetation and easy to cross with farm machinery. Offset drainpipe to protect it from washing out.

BMPs for Design and Construction

Grassed waterways

It is important to design and construct the grassed waterway properly. If it is not sized and shaped correctly, flows may regularly exceed its capacity and its usefulness will be short-lived.

Proper seedbed preparation is important to establish grass cover. Mulch the area with straw to help seed germination and give short-term protection from runoff events.

This 27-year-old waterway has been functioning as designed ever since it was installed. The waterway has worked well, even though cropping is done parallel to the channel for part of the waterway. Its success can be credited to proper care and regular maintenance, including mowing the grass cover once or twice a season, and keeping all field operations (spraying, cropping and cultivation) away from the grassed area.

BMPs for Maintenance

Grassed waterways

Grassed waterways are designed to carry predicted flows of surface runoff generated from a 10-year frequency storm. The width and depth help control velocities. Generally, side slopes of 10:1 (horizontal:vertical) are recommended. This shape will allow for farm machinery to cross easily. Drainpipe should be placed underneath the grassed waterway to handle low-volume flows.

Regular maintenance is required to ensure the ongoing and long-term functioning of the grassed waterway.

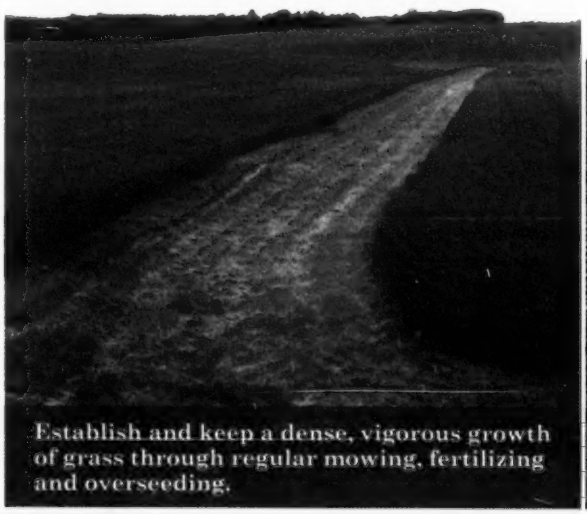
DO:

- Raise farm implements when crossing the waterway.
- Harvest forage crops from the grassed waterway.
- Avoid spray drift.

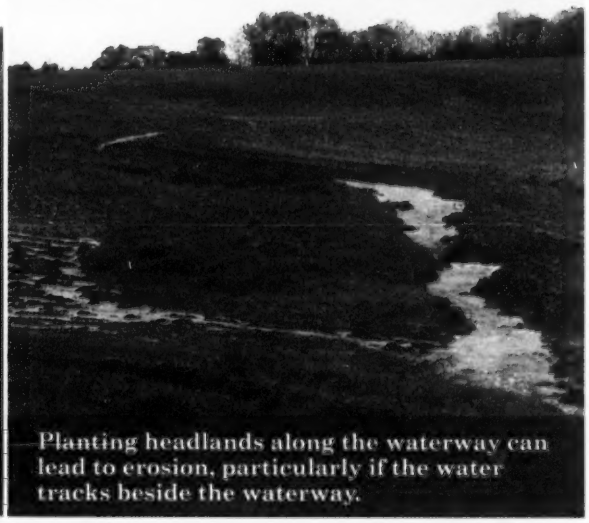
DO NOT:

- Spray with herbicide.
- Use the waterway as a travel lane or as a turning strip during field operations.

Avoid planting rows parallel to the waterway.



Establish and keep a dense, vigorous growth of grass through regular mowing, fertilizing and overseeding.



Planting headlands along the waterway can lead to erosion, particularly if the water tracks beside the waterway.

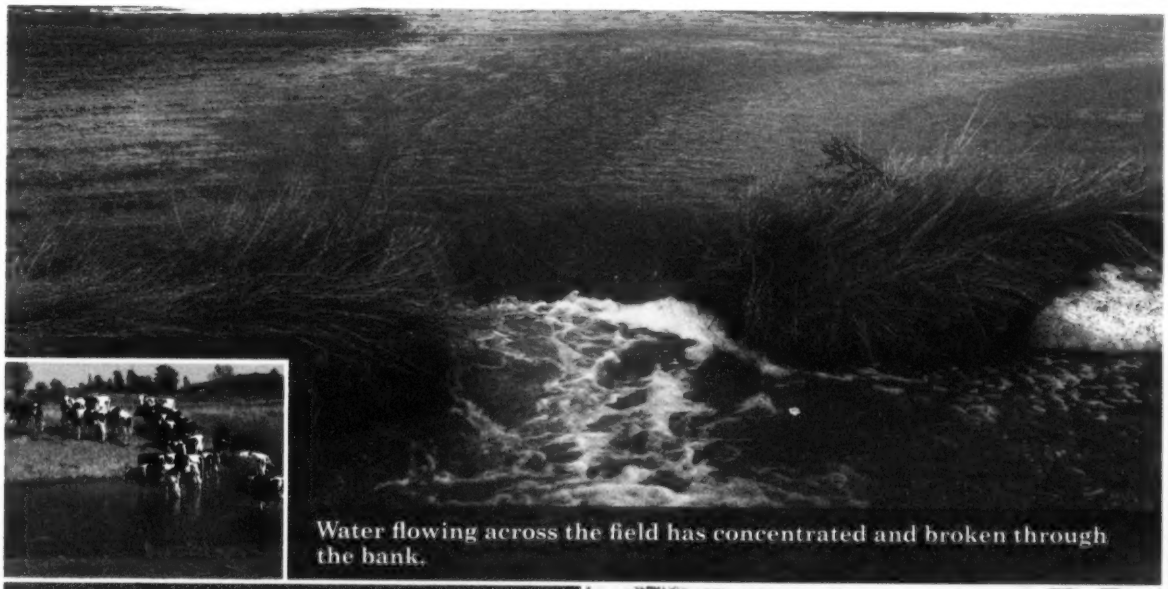
Bank Erosion

Cropland drainage is essential for farming in Ontario. Natural streams and constructed drainage channels act as outlets for surface runoff and for subsurface drainage systems. Ensuring their continued and efficient functioning will serve the farm well.

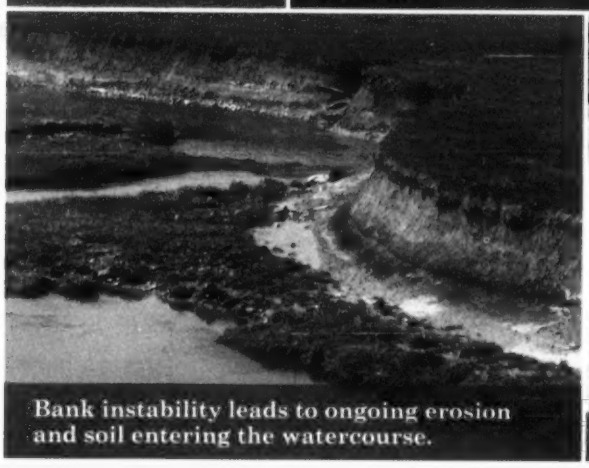
Some management is necessary to assure the proper functioning of drainage channels and to sustain fish and wildlife habitat in agricultural areas.

You are experiencing excessive erosion in or along a watercourse if:

- concentrated runoff is flowing over the bank, and banks are slumping
- outlet pipe areas are unstable and soil has washed out from around them
- the banks of the stream or drainage channel are being undercut and scoured
- high-density streamside grazing has led to the exposure of erodible bare soils.



Water flowing across the field has concentrated and broken through the bank.



Bank instability leads to ongoing erosion and soil entering the watercourse.

Soil has washed away around this outlet.

BMPs for Bank Erosion

There are often regulatory considerations when working in or around a watercourse. Contact your local municipality, Conservation Authority or Ministry of Natural Resources office before starting a project.

Exclude livestock from watercourses by fencing. Provide an alternative water supply.

Subsurface drainage outlet pipes should point downstream. They should be be protected by a rigid pipe with hinged rodent gate, and rock-lined splash pad with filter-cloth underlay.

Well-vegetated banks and buffer strips are often all that is needed to stabilize a watercourse.

A stone lining with filter-cloth underlay can solve minor erosion problems.

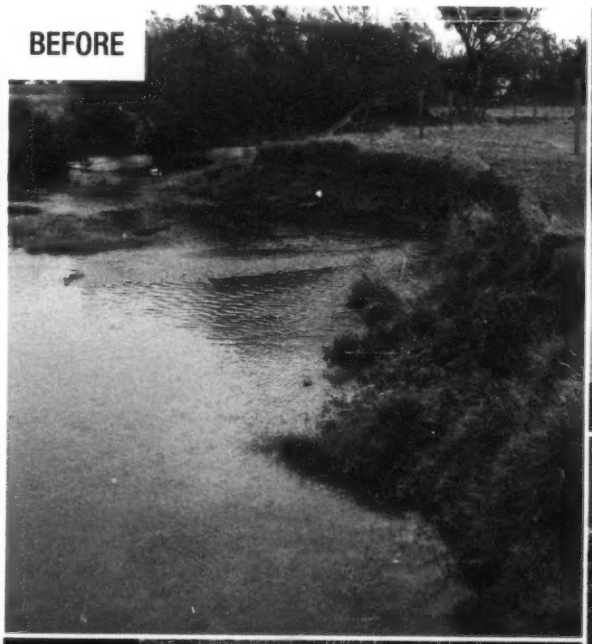
To be effective, a rock-lined spillway is adequately sized, and made of filter-cloth underlay and properly sized angular stone.

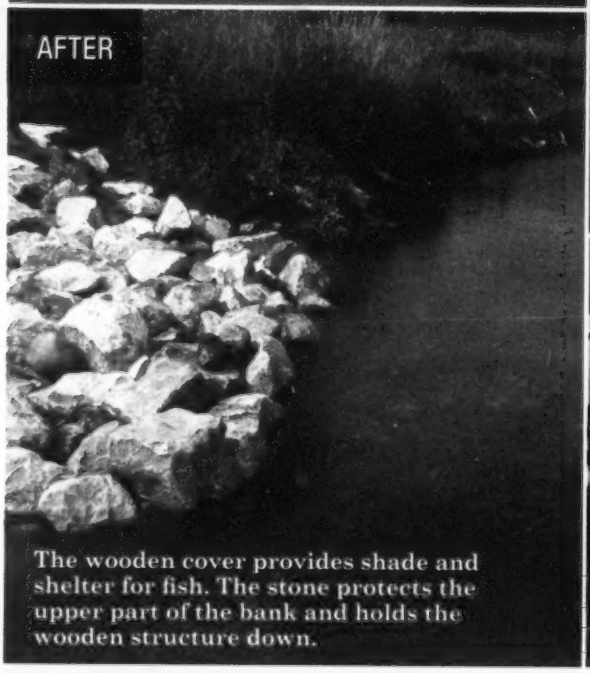
BMPs for Bank Erosion

Innovative approach

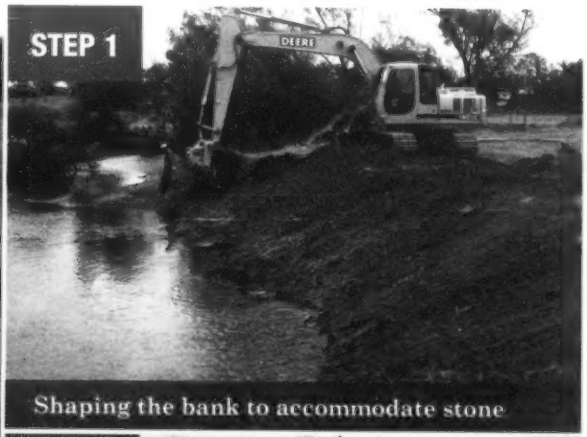
This stream was experiencing bank erosion and required some minor repair. The bank was protected using a wooden bank cover structure supported by stone and filter-cloth underlay to accommodate fish habitat. Stream flows will keep the area free of sediment buildup so that fish can find shelter.

Shortly after the installation, sampling found over 17 fish species using the area.

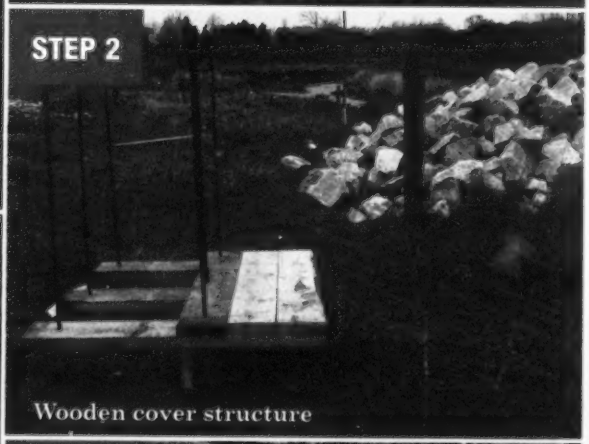




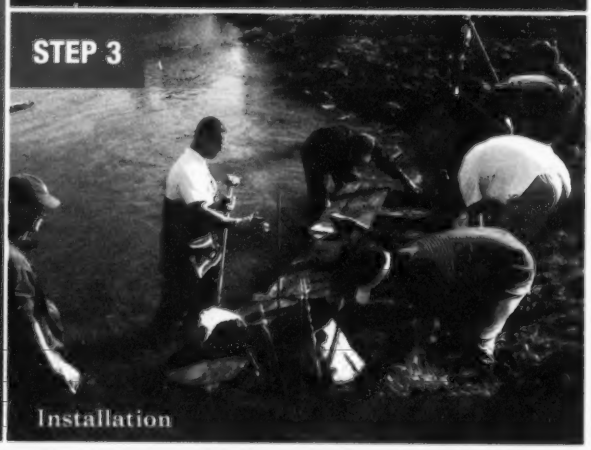
The wooden cover provides shade and shelter for fish. The stone protects the upper part of the bank and holds the wooden structure down.



Shaping the bank to accommodate stone



Wooden cover structure



Installation

BMPs for Bank Erosion

Progressive solutions

Building natural stream functions into drainage channel design and construction will reduce long-term maintenance costs. Progressive drain design may include riffles and pools as part of the construction. These features encourage natural stream flow patterns, move water and sediment efficiently, and improve fish habitat. This solution is intended for permanently flowing streams.

Progressive solutions are fish-friendly and include:

- bioengineering
- wooden cover structures
- root wad structures.

Many of these ideas can be incorporated into municipal drainage systems.

Riffle and pool in drainage channel

During construction

1 year after construction

Dogwood cuttings strapped to the bank take root and protect against erosion.

Wind Erosion

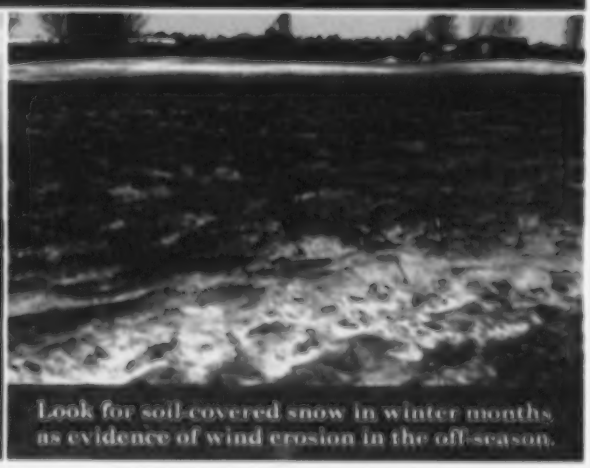
Wind erosion is the process of detachment, movement and deposition of soil by the action of wind. It can occur on any soil type, but is more common on sandy soils and particularly organic or muck soils.

Your soil is suffering from wind erosion if:

- airborne soil is regularly seen under windy conditions
- during winter, the snow cover has a brown colour
- soil has accumulated on the leeward side of any type of barrier, e.g. fence rows, buildings, trees, ditches or streams
- fence rows may be much higher than the field border
- the soil surface appears smooth or rippled, like beach sand
- crops have been exposed, sandblasted or buried by soil.

Airborne soil particles above muck cropland.

The crops in this field have been sand-blasted and partially covered by wind-blown sands.



Look for soil-covered snow in winter months as evidence of wind erosion in the off-season.

BMPs for Wind Erosion

Isolated areas within a field, such as sandy knolls

There are two main approaches to controlling wind erosion:

- **reduce wind speed at ground level**
- **cover and protect the soil surface.**

SOLUTION

No-till or **mulch till** in isolated high-risk areas may be enough to hold the soil, particularly over winter. Another option is to use a **cover crop**. If the area is very prone to erosion, consider a cover crop that overwinters, like wheat or rye.

Conservation tillage protects the soil surface from wind erosion with crop residue.

In many intensive vegetable production systems, plastic mulch covers much of the soil. While the mulch protects the soil from wind erosion, it can increase water erosion problems.

Cover crops such as red clover under-seeded in wheat keep the field protected.

BMPs for Wind Erosion

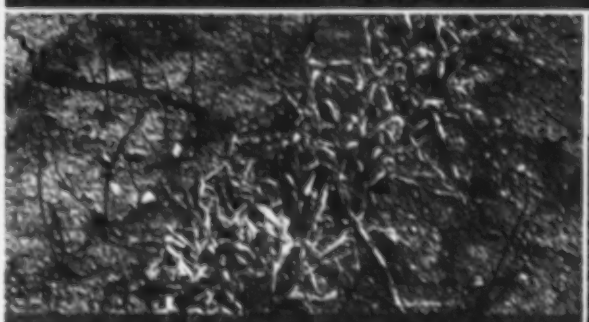
Large areas of the field or whole fields

Rye, wheat or spring grain can be planted as annual windstrips. Windstrips will provide adequate wind protection if spaced properly. Grasses bend under pressure of the wind, which reduces the effective protected area. Consider the height of the grasses when protection is needed, and use a factor of 5–7 times the height of the upright grasses to estimate the protected area. This concept is explained on the next page.

SOLUTION

Tillage systems that leave **residue on the field** and **cover crops** to protect the soil over the winter are a must on fields that experience high levels of erosion. Spring tillage and planting pose a greater risk for wind erosion. Use **windstrips** to reduce wind speed and carrying capacity.

Windstrips provide flexible wind protection for high-value land. They can also be used either in combination with windbreaks or as a transitional measure until tree windbreaks are large enough to provide sufficient protection.

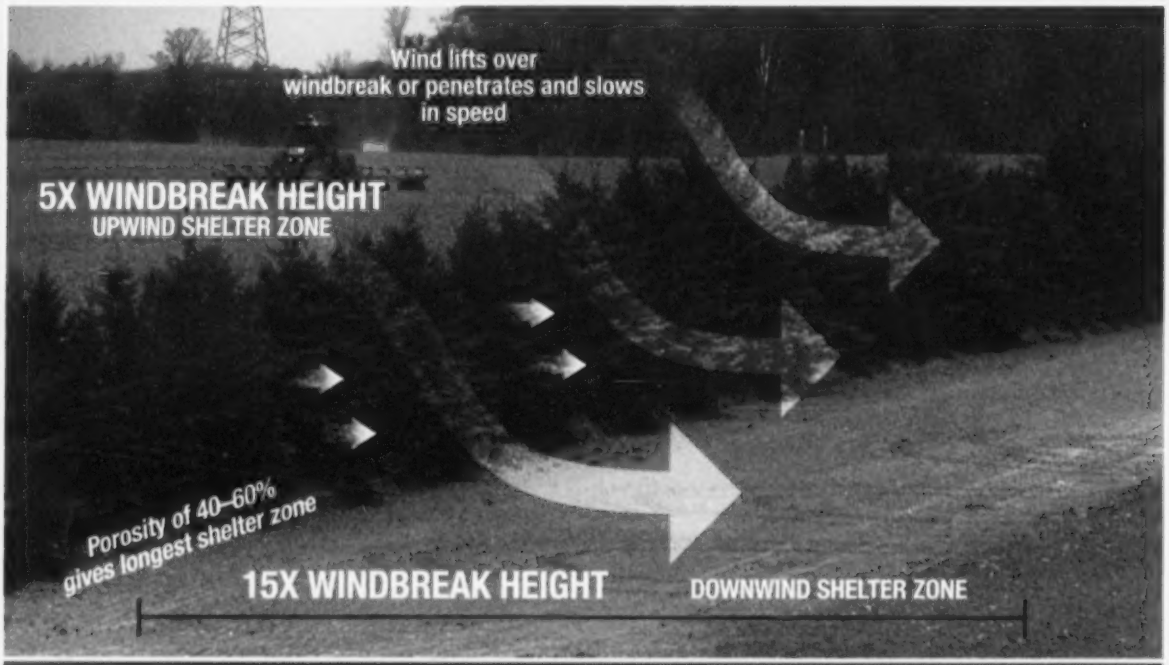


Muck soils are much more erodible than sandy soils. Barley can be planted between rows of onions or carrots to provide early season wind erosion control. The barley can be controlled by herbicides so that it doesn't compete with the crop.

Cover crops such as rye, wheat and oats can be used to create windstrips for crop protection.

BMPs for Wind Erosion

Windbreaks


Wind lifts over windbreak or penetrates and slows in speed
5X WINDBREAK HEIGHT
UPWIND SHELTER ZONE
Porosity of 40–60% gives longest shelter zone
15X WINDBREAK HEIGHT
DOWNWIND SHELTER ZONE

"For every 10 feet in height of a tree windbreak, you will see an increase in yield for approximately four to five times that – 40 to 50 feet – into the field."

Earl Elgie, Kent County

BMPs for Wind Erosion

Entire field or farm

SOLUTION

- Plant tree **windbreaks** along fence rows.
- Complement with tillage systems that leave **residue** on the field.
- Use **cover crops** that protect the soil when not in crop.

Effective wind erosion control management may include tree windbreaks and a variety of other approaches. As little as 20–30% crop residue cover can be highly effective in protecting soil from wind erosion.

The use of plastic mulch during planting will reduce the need for weed control during the first five years.

A successful windbreak tree planting project requires maintenance: occasional pruning, in-filling dead trees, thinning as trees mature, and watering young trees during prolonged drought conditions.

Highly Erodible Land

Highly erodible land is an area that is prone to significant erosion from wind, water and tillage. Soil type and topography combine to make erosion control difficult or impossible in a cropped system.

Plant grass, shrubs or trees to improve biological diversity. This will mean more birds and beneficial insects such as bees and ground beetles.

Depending on how it is retired, the land still may be able to provide income while protecting the soil. Alternative uses may include perennial grass for forage or biofuel, trees for timber and other forest products, or recreation.

SOLUTION

Sometimes slopes are too steep for erosion control. **Retire that land**: it will save you time, effort and money.

Farming with Erosion Control Structures

Maintenance – Protect your erosion control investment with an ongoing maintenance plan. This plan will determine how effective the structural controls are and how long they will last. In general, all erosion control structures should be inspected regularly and repaired as concerns are found. More specific maintenance recommendations are provided within the booklet.

Manure Application – When spreading livestock manure, maintain a minimum distance of 30 metres (100 ft) from open watercourses, catchbasins and standpipe inlets. The EFP Worksheet #17: Use and Management of Manure and Other Organic Materials and the BMP book *Manure Management* provide excellent recommendations regarding the use of manure on farm fields.

Equipment and Management – When designing an erosion control project, remember your existing field implements and management choices. Are you thinking of a change to no-till? Will you be purchasing a planter or drill that is wider or narrower than your present equipment?

Climate Change – Storm events seem to be getting more sudden and intense. This can greatly affect soil erosion if the land is not prepared for it. Fields may be very vulnerable to both wind and water erosion, especially in the late spring or when the crop canopy hasn't closed. It is important to consider the potential for soil erosion all year long.

Markets and Crops Grown – Farmers attempt as best they can to adjust to consumer demands for new and different crops and management methods. Changes to your management system may necessitate adjustments to your erosion plan as well. This may include major changes such as a switch to organic farming or horticultural crops, or moving to a different type of livestock – or simply modifying crop rotations.

Impacts on Neighbours and Others – In most cases, soil erosion problems and controls are not limited to a property boundary. For example, much of the runoff on your farm may be originating from one or several properties upslope. If possible, try to involve all the affected landowners in the planning process, as it should lead to a better overall erosion control plan. Consider a municipal drainage approach if suitable. At the very least, get your neighbours' approval if your proposed best management practices could affect their property.

What Else Should You Consider?

The Environmental Farm Plan (EFP) is a voluntary education and awareness program designed to help Ontario farmers prepare environmental risk assessments for their farms. The workbook provided to EFP participants offers management alternatives for all parts of the farm operation. It includes information about soil erosion control, and offers regulatory guidance. Keep all records associated with soil erosion projects with your EFP.

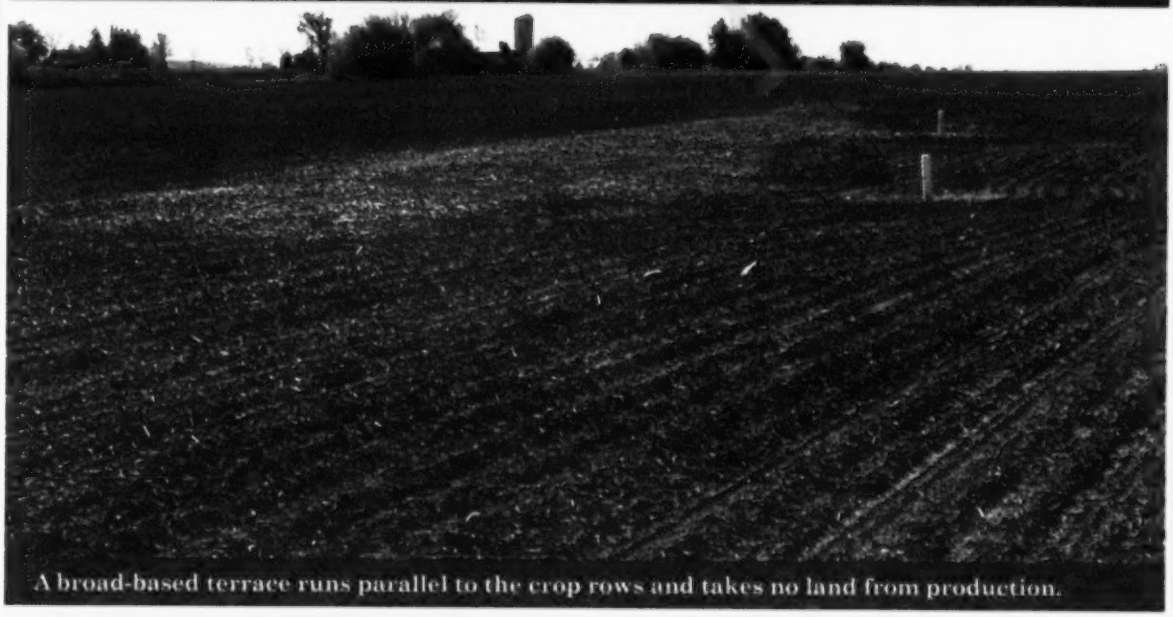
Legislation – Your local municipality must be made aware of any work along an open municipal drain, and of anyone using a municipal drain (whether open or closed) as an outlet. There are timing and other restrictions around projects involving drainage channels and streams, whether or not municipal drains are involved. Your local Conservation Authority (CA) or Ministry of Natural Resources office can provide assistance with these projects. In most cases, Fisheries Act concerns can be addressed by CA staff.

The Bottom Line

Save time and improve your field operations!

Many farmers live with rills and small gullies on the farm. They leave the areas idle or fill them in year after year. In some instances, erosion is so bad that fields are broken up or divided. This requires more energy and time to manage than a single field. A workable erosion control plan can bring these areas back into productive land use and protect them over the long term.

This gully has taken over 2 hectares (5 ac) out of production. This represents over 1,016 tonnes (1,000 tons) – or 65 tandem truckloads – of soil and associated nutrients being washed away!



A broad-based terrace runs parallel to the crop rows and takes no land from production.

The Bottom Line

The investment you make in soil erosion control and management will pay off, and not just economically.

Consider...

- If soil erosion is allowed to occur, the land's productivity is reduced.
- Using rotations requires less pesticide and reduces associated costs.
- The investment you have made in drainage to improve your farm is likely substantial. Soil erosion control is often dependent on good drainage systems. They work hand-in-hand.
- Municipal drainage is costly. These costs may be reduced when soil erosion is controlled near or at the source – rather than allowing soil to fill ditches that require cleaning out.
- Sediment in streams harms valuable fish habitat.

Did you know... 1 ton/acre of topsoil = thickness of one sheet of paper
= 4 lbs available nitrogen
= 1.5 lbs phosphorus
= 5 lbs potash

Resources for Additional Help

In-person advice and assistance:

Certified Erosion Control Contractors
OMAFRA provides training to contractors in structural erosion control design. The list of contractors is available through OMAFRA at **1-877-424-1300** or **ag.info.omafra@ontario.ca**.

Conservation Authorities
There are 38 Conservation Authorities across Ontario, many of which provide technical services in erosion control. You can find the link to your local CA office through Conservation Ontario at **www.conservationontario.ca/find/index.html** or call **1-905-895-0716**.

Drainage Superintendents Association of Ontario
Contact your local drainage superintendent through your local municipality or **www.dsao.net**.

Certified Crop Advisors of Ontario
Many farm operations rely on their professional advice. Contact an advisor through **www.ccaontario.com**.

Other information and technical publications are also available:

Ontario Ministry of Agriculture, Food and Rural Affairs	**1-877-424-1300**, **ag.info.omafra@ontario.ca** or **www.omafra.gov.on.ca**
Agriculture and Agri-Food Canada	**www.agr.ca**
Fisheries and Oceans Canada	**1-800-290-3731** or **www.dfo-mpo.gc.ca**
Ontario Ministry of Natural Resources	**1-800-667-1940** or **www.mnr.gov.on.ca**

Local and Provincial Cost-Sharing Opportunities

There are often cost-sharing opportunities for farmers willing to invest in soil erosion control. A key part of the Environmental Farm Plan program is its link to federal and provincial funding programs. Contact your local EFP representative for more information. The provincial list of EFP representatives is available at **www.ontariosoilcrop.org** or call **1-800-265-9751**.

In many parts of Ontario, there are also other cost-sharing programs designed to meet local environmental needs and objectives. These initiatives may be funded by municipalities, foundations and other private granting organizations, and can often be used to top-up EFP grants. In most instances, the local EFP representative or Conservation Authority administers these grants. (Please see above for help in contacting your local CA.)

Resources for Additional Help

Publications

BEST MANAGEMENT PRACTICES SERIES	
Buffer Strips	Order No. BMP15
Cover Crops	Look for it soon
Cropland Drainage	Order No: BMP25E
Establishing Tree Cover	Order No. BMP21E
Fish and Wildlife Habitat Management	Order No. BMP01
Irrigation Management	Order No. BMP08
No-Till: Making it Work	Order No. BMP11
Nutrient Management Planning	Order No. BMP14E
Soil Management	Order No. BMP06E
Streamside Grazing	Order No. BMP19E
Water Management	Order No. BMP07

OMAFRA PUBLICATIONS	
Agricultural Erosion Control Structures Publication 832	Order No. 0832E
Considerations for Stable Open Ditch Construction	Order No. 85-067
Control of Soil Erosion	Order No. 95-089
Drop Inlet Spillways	Order No. 85-057
Grassed Waterways	Order No. 09-021
Gully Erosion Control	Order No. 88-059
Legislation and Farming Practices	Order No. 04-071
Maintenance of the Drainage System	Order No. 87-062
The Planning and Maintenance of an Erosion Control System	Order No. 97-015
Seeding of Erosion Control Projects	Order No. 90-231
Soil Erosion – Causes and Effects	Order No. 87-040
Strip Cropping for Water Erosion Control	Order No. 89-171
Universal Soil Loss Equation (USLE)	Order No. 00-001
Use of Earthen Berms for Erosion Control	Order No. 99-047
Water and Sediment Control Basins	Order No. 89-167

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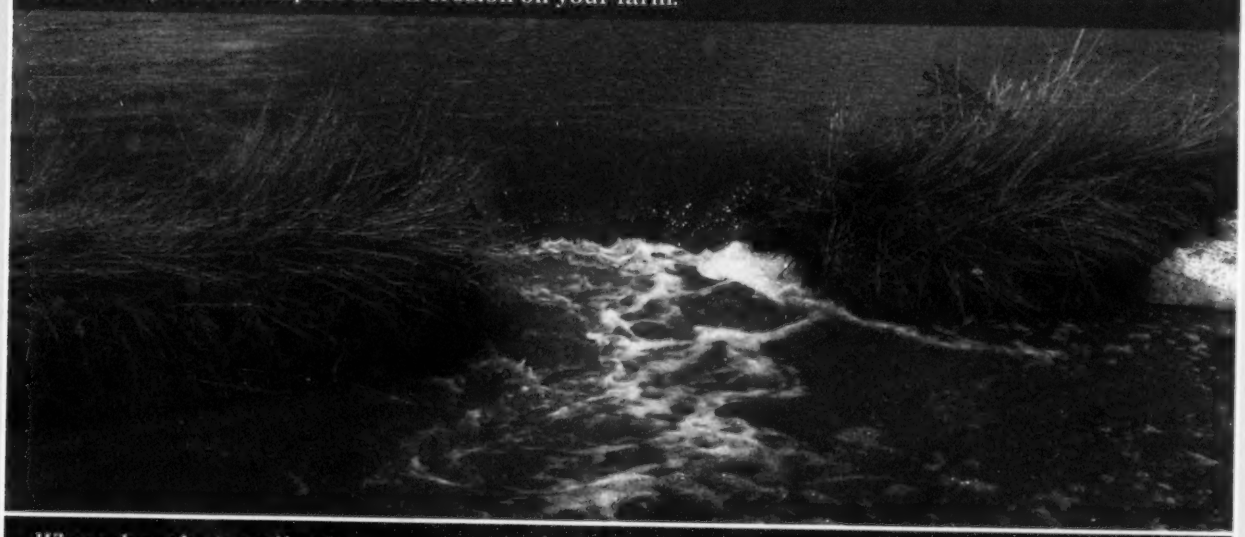
Poor soil management practices have adversely affected water quality. In Ontario, the Great Lakes ultimately feel the impact of soil erosion on your farm.



Where does the topsoil go?
Sediment plumes stretch out into the Great Lakes, February 25, 2008. Source: NASA Visible Earth.